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ABSTRACT

Six major topics in the recent literature on class size concern the relation of class size to: (1) children's achievement; (2) other child variables, such as pupils' attitudes and behavior; (3) teacher variables, such as satisfaction and stress; (4) organization and instruction; (5) cost-effectiveness; and (6) the unique characteristics of small classes. This review discusses these topics and cites examples of studies on each topic. (RH)

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JUNIOR SCHOOL CLASS SIZE: WHERE ARE WE NOW?

By Valerie N. Podmore

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CLASS SIZE has been under scrutiny for almost a century. During the 1970s and 1980s there have been extensive reviews of the effects of class size and of related matters. The intention of this further review is to catch up with recent research on class size in the first years of school.

Six major topics are evident in the more recent literature on class size. These are:

1. Class size and children's achievement;
2. Class size and other child variables (pupils' attitudes and behaviour);
3. Class size and teacher variables (satisfaction and stress);
4. Class size, organization and instruction;
5. Class size and cost effectiveness;
6. The unique characteristics of small classes.

This review is organized around these themes, and examples are given of studies from each of the six groups.

Class size and children's achievement

According to two prominent US analysts of class size, Glass and Smith (1978), there have been four different stages in the development of the research concerned with class size and pupils' achievement. Glass and Smith describe these stages as

- ...the pre-experimental era (1895-1920);
- the primitive experimental era (1920-1940);
- the large-group technology era (1950-1970);
- the individualisation era (1980-present).

The research methods used to study class size have become more complex, as the complexity of the subject has been revealed. Unfortunately studies are still quoted, and even carried out, that use inadequate research methods. We need to be cautious about results which give simplistic answers.

History

Critical events, like the rising birth rate in a number of countries during the late 1940s, the expansion of teaching technology in the US during the 1960s, and the emergence of professional unions and associations of teachers, have influenced interest and interpretation. For example, Glass, Cahen, Smith, and Filby in 1982 pointed out that a number of researchers conducting experimental studies in the US between 1957 and 1964 concluded that older secondary school students learnt as well in larger classes (40 to 50) as in smaller classes (20 to 30).

However, the older students were children who had been born during the 1940s baby boom, and the weight of their numbers had stretched educational resources. Consequently Glass and colleagues questioned whether the researchers, by reporting that 'research proves that although enrolments may double, costs may stay the same', were 'discovering the facts that the educational establishment of the time wanted to hear'.

Through the decades, interpretations of the class size research have been made which sprang from the social and cultural ideas of the day, and were constrained by political realities.

Glass and Smith

Class size certainly became a more prominent concern of Teachers, researchers, and administrators after Glass and Smith published their own research in 1978 and 1979. They reviewed and brought together the findings from 77 studies which included 725 comparisons of achievement in different-sized classes. These studies had been carried out in 12 different countries. They used the technique of meta-analysis to aggregate the statistical results across the studies. The meta-analysis results showed that there was an overall tendency for more marked gains to occur among students in classes of less than 20.

More specifically, Glass and his colleagues concluded that if a student were taught for more than 100 hours in a class of 20 pupils, her or his achievement would exceed that of 60 percent of pupils taught in class sizes of 40. In addition, achievement gains were clearly evident for pupils in very small classes of 15 or fewer students.

Reaction but not rout

Another research group in the USA, Educational Research Service (ERS), has strongly criticised Glass and Smith's methods and conclusions. However, in their own review of the class size research, ERS did conclude tentatively that small classes are 'important to increased pupil achievement in reading and mathematics in the early primary grades.' ERS did not dispute the relevance of small class sizes to achievement in the first years of school but they did point out that research findings repeatedly show that 'the relationship between pupil achievement and class size is highly complex.'

More recently, statisticians Hedges and Stock have responded to the criticisms of Glass and Smith's report, by using alternative statistical methods to analyse the original data. Hedges and Stock found, though, that even when more

rigorous optimal statistical analyses were performed. Glass and Smith's meta-analysis results were not affected in a major way:

Smaller classes will still lead to higher expected achievement than larger classes. Also, tests of significance confirm that class size accounts for a substantial amount of achievement variation (while also indicating that substantial sources of systematic variation remain to be explained).

Another indicator of achievement

The studies included in Glass and colleagues' meta-analyses tended to define achievement in relation to children's performance on educational tests, or as teacher assessments of reading or mathematics. However, in the 'pre-experimental era' of the 1900-1920s prior to the introduction of social promotion in the US, some researchers used promotion records as measures of achievement. A much more recent study conducted in West Germany has included class size in the first years of school as one of the factors that is important (an intervening variable), the results of which can be seen in non-promotion (an outcome variable).

This work by Tietze was not an experimental study, but a detailed analysis of the data obtained from official statistics gathered from elementary schools in one West German State. In a paper based on his preliminary analyses of the official statistics, Tietze in 1987 developed an evaluation model and demonstrated that the process variable 'class size' influenced both children's retention in Grade 1 and 2 and their assignment to special classes.

Class size as an indirect cause

Many researchers now suggest that the relationship between class size and achievement is likely to be indirect. Vignocchi concluded that researchers need clear working definitions of large and small classes, and carefully controlled experimental designs. Factors such as instructional methods and materials, age and class level, and numerous characteristics of both teachers and pupils need to be considered when evaluating class size effects.

It seems reasonable to suggest that we have now entered a fifth stage of class size research. With the increased sophistication of research methods and a rising concern with the context in which children's development and education takes place, this fifth (1980s-) phase of the class size research could be described as the era of 'the intervening variables.' Current knowledge tends to suggest that class size can influence classroom processes, and that the impact of class size on young children's achievement is indirect, perhaps via the changes in the way teaching can be carried out in smaller classes. A change in class size (leaving instruction still in a style suited to large classes) will not bring about better learning directly, nor automatically.

Class size and other effects on children

A child's age, ethnic or cultural background and many emotional factors affect the experiences a child has in the classroom and school. These are important considerations in studies of class size. Several recent publications have reported strong links between class size and children's emotions, motivation, and classroom behaviour.

Glass's work

Glass and colleagues have described improvements in pupils' attitudes and behaviour (pupil 'affect'), improvements in teacher 'affect', and improvements in instructional techniques when class size is reduced. To ascertain the quantitative relationship between class size and pupil/teacher affect, they plotted logarithmic curves based on 371 comparisons from 59 studies. One study was British, one Australian, 15% of them were Canadian, and the remainder were from the USA. Pupil affect was defined as an aggregation of 30 characteristics including self-concept, attendance, study habits, motivation, attention, anxiety, and student social interaction. Their analyses showed that the average pupil in a class of 30 is at the 50th percentile in attitude (for example,

towards the class or the subject), but the average student in a class of 10 is at nearly the 70th percentile in attitude. Glass *et al.* concluded that class size

affects pupils' attitudes, either as a function of better performance or by contributing to it. In smaller classes, pupils have more interest in learning. Perhaps there is less distraction.

They also concluded that the behaviour of pupils in smaller classes is more frequently on-task than the behaviour of their counterparts in larger classes.

An Australian study

In an Australian study, (see *set* No.1, 1983, item 12, 'Three Dozen's a Crowd') Campbell and Robinson have shown somewhat similarly that when a class is reduced from 36 to 26, pupils attend to the teacher more, are somewhat less withdrawn and are less aggressive. Campbell and Robinson's study of class size effects was a natural experiment; changes in suburbs were bringing about changes in the local schools. Three groups were involved: the first group was 10 classes which had received a 36 to 26 reduction in class size, the second was a control group of 2 classes of 36 children - these control group classes had *not* reduced in size, and the third group contained 2 classes that *increased* in size from 22 to 32 (included to control for the effect of change *per se*). All were primary school classes and the authors reported some age effects. Younger primary school children were described as more affected by crowding than older children. No differences in class size effects were found however, that could be attributed to child gender. Campbell and Robinson also suggested that, if the effects of crowding on pupils' behaviour are to be minimized, the ideal class size might be between 15 and 20 pupils, but they did stress that this was merely speculation.

Overall

Overall then, there is consensus that small class size has a positive effect on pupil behaviour during the early years of school. Children's attitudes, and more specifically their classroom behaviour, seem important variables to consider when analysing class size effects in the junior school.

Class size and teacher variables

Glass and colleagues reported some strong relationships between class size and seven variables: teacher organization and planning, morale, attitude toward students, perceptions and satisfaction, workload, absences, and professional growth. The curve plotting the relationship between class size and these effects showed a strong link: teachers' morale etc., increased sharply as class size fell. If a class of 30 pupils is reduced to 20 pupils, the teacher's satisfaction and morale increases considerably.

Class size is one of many variables characteristically included in studies of teacher stress, turnover, satisfaction, or burnout. Galloway's research on teacher stress provides a local example. Sponsored in part by the New Zealand Educational Institute, the primary teachers' union, this project illustrates that the growth of teacher unions and associations has led to increased interest in class size research. Galloway and his associates distributed a questionnaire on teacher satisfaction and dissatisfaction to primary teachers in the lower half of the North Island. After factor analysis Galloway reported that class size combined with other variables to form a teacher satisfaction factor, which he called 'school administration and conditions of employment'. Other variables also impinged upon teachers' satisfaction with the administration and employment conditions under which they worked. For example, the age and duties of their principal were important - if the Principal was under 50 and a teaching head there was greater satisfaction. Playground organization was also important.

The study by Galloway demonstrates that interpreting this area of research can be complex. In their analyses, class size was merged with other aspects of teaching and working conditions. However, their findings provide support for the view that small class size interacts with classroom processes and good school administration to give teacher satisfaction.

Class size and organisational/instructional variables

Some class size researchers have moved on to investigate instructional groups within classes. Some North American schools make use of cross-age tutoring (older children tutoring younger ones), pull-out programmes (where children are withdrawn from the regular classroom for extra instruction), developmental programmes, learning centres, team teaching, staggered or split scheduling (different types of timetabling), and subject-matter groupings. Although much of the class size research summarized in this review has been concerned with whole-class instruction by one teacher, some studies have also looked at ways in which small groups can be used effectively within classes.

Mathematics and large classes

One Australian study of children in their fifth year at primary school has indicated that mathematics achievement may not be enhanced by small **group** teaching if this takes place in larger classes. Bourke has developed a causal model linking teacher background, class size, teaching practices, and mean class achievement in mathematics (as measured on a test of the four arithmetical operations with whole numbers). Regression analyses showed that larger classes and more group work were associated with lower achievement, whereas smaller classes and whole-class teaching were associated with higher achievement in mathematics. (Class sizes ranged from 12 to 33 students, with an average of 25.2). Whole-class teaching, prompting or probing students after asking a question, setting more homework, and having quieter classrooms were teaching practices that appeared to facilitate higher achievement in the smaller classes.

Streaming

Other researchers have demonstrated that work in small groups can increase the amount of contact between teachers and pupils. However, grouping young children according to their general ability has an adverse effect on the expectations and achievement of the children who are assigned to the lowest groups.

Distributing teachers' attention

When class size is reduced, there is scope for the frequency or duration of interactions between the teacher and each student to increase. Hill, another US researcher, considers that lowering class size to 20 or fewer may improve the distribution of teacher-child interaction and lead to children's optimal achievement. For smaller class sizes to benefit all children equally, though, teachers would need to get equal participation from all children. International research certainly suggests that class size effects are strongly influenced by class or group dynamics and by the distribution of teachers' attention to different children.

Minority pupils

Savard and Cotton, who have reviewed recent research on effective schooling for migrant groups in the US, have pointed out that both class size and grouping arrangements within classes have specific effects on minority pupils. Fifteen or fewer in a class and small groups within classes were seen as beneficial to minority group pupils, provided the groups were not streamed for ability. The effects of class and group size were also influenced by instructional processes, and better results came when there were systematic instructional patterns, more frequent teacher-child interaction, and prompt teacher feedback. Savard and Cotton concluded that, despite the expense, small classes are justifiable for minority groups if teachers simultaneously adopt instructional methods suitable for smaller sized groups.

In New Zealand Geraldine McDonald's recent study of Maori and non-Maori children's promotion suggests that small class size does not automatically ensure an equitable deal for all children. She found no improved promotion opportunities for Maori pupils whether classes were small or large. In fact in small classes the rate of promotion out of the junior school was larger for non-Maori children. Decreases in school

size or class size need to be combined with different promotion practices.

In summary, when class size is reduced, the outcomes for pupils are likely to be influenced by (i) aspects of organization, (ii) aspects of instruction in the classroom, (iii) aspects of our whole society. Reducing class size is likely to benefit minority group pupils only if it is accompanied by changes in what society values, changes in classroom interaction and instruction, and changes in school structures such as promotion practices.

Class size and cost effectiveness

There are ongoing debates in the literature about the cost effectiveness of reducing class size. Levin and colleagues have used meta-analysis to compare the cost effectiveness of four different educational interventions: peer and adult tutoring, computer-assisted instruction, reductions in class size (from 30 to 25, 25 to 20, and 35 to 20), and increases in instructional time. Their research showed that peer and adult tutoring was the most cost-effective change. Class size reduction and increasing the length of the school day were least cost effective, with computer-assisted instruction falling in the middle of these options.

Levin's study could be used in arguments against reducing class size. Closer scrutiny of their findings shows, though, that the outcomes were measured in mathematics and reading scores alone. There was no analysis of the affective (social, emotional, morale) benefits for children or teachers. Further, the researchers calculated the cost of class size reduction with an extensive allowance for classroom facilities – including new classrooms, physical space, furnishings, energy needs, insurance and ongoing maintenance, some of which do not apply if rolls are falling, as they are in some places, at present.

However, Levin's findings suggest that class size reductions might be more cost effective if combined with systematic instructional changes, like increasing peer tutoring, and enhancing the content and distribution of teacher-child interactions so that all children receive more attention from the teacher.

The unique characteristics of small classes

Finally, some recent studies have been designed to investigate the characteristics and dynamics of small classes. As Berger and the authors of an *Educational Research Service Staff Report* have noted, the concept of 'small class size' constantly changes. Educational Research Service has described class sizes of 23 to 24 as the break point – over that and teachers regard the class as large, and a problem. Some experimental studies of small classes now focus on classes of 10 to 15 pupils.

In a study still in progress in Nashville, Tennessee, Bain and colleagues have studied the effects of a 1:15 teacher-pupil ratio on first-grade children's behaviour, attendance, self-concepts, and achievement in reading and mathematics. Children in seven 1:15 classes were compared with those in control group classes. Two control groups were included. One group comprised classes from a comparable neighbourhood school where class size was described as normal (25 children). The other was a control group of first-grade students from 25 elementary schools, and these children were matched with the experimental group on sex, race, socio-economic status, age, and pre-reading scores on entry to school.

Preliminary results reported during the first year of the study showed that the experimental group (1:15) children were performing significantly higher than the control group children on reading and mathematics. However, no major differences were found between groups on self-concept. The teachers completed a 24-item Inventory of Classroom Conditions, and there was a strong trend for the experimental group (1:15) teachers to score higher on items concerned with instruction and attention to individual students. The authors noted with interest that the small class size benefited children from both higher and lower socio-economic backgrounds, in reading and mathematics. They recommend looking for the source of the improved learning and detailing how small class size improves teaching and learning opportunities.

Notes

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Previous items on class size in *set* are

'Are small classes better than big classes?' *set* No. 1, 1975, item 6.
'Teachers' attitudes on class size.' *set* No.1, 1975, item 6. 'The Class Size Issue Rides Again.' *set* No.1, 1980, item 9. Campbell, J and Robinson, M. 'Three Dozen's a Crowd.' *set* No.1, 1983, item 12.

Class Size and children's achievement

The stages in class size research are quoted from work by Glass and Smith. These two researchers caused a stir in the field by applying the meta-analysis technique. The two most important sources for their work are

Glass, G.V., and Smith, M.L. (1978). *Meta-analysis of Research on the Relationship of Class Size and Achievement*. San Francisco: Far West Laboratory for Educational Research and Development.

and

Smith, L.E., & Glass, G.V. (1979). *Relationship of Class-size to Classroom Processes, Teacher Satisfaction, and Pupil Affect: A Meta-Analysis*. San Francisco: Far West Laboratory for Educational Research and Development.

The effects of the rising birth rate and other factors on class size research are detailed in

Glass, G.W., Cahen, L.S., Smith, M.L., & Filby, N.N. (1982) *School Class Size: Research and Policy*. Beverly Hills: Sage Publications

Other work about meta-analysis of class size research includes

Cahen, L.S., Filby, N., McCutcheon, G., and Kyle, D.W. (1983). *Class Size and Instruction*. New York, N.Y. Longman.

and

Hedges, L.V., & Stock, W. (1983). The effects of class size: An examination of rival hypotheses. *American Educational Research Journal*, 20:1, 63-85.

The critical work of ERS is found in

Educational Research Service (ERS). (1978). *Class size: A Summary of Research*. Arlington, Virginia: ERS.

Using promotion records to research class size; see Cornman (1909) in Glass, Cahen, Smith and Filby (1982) mentioned above

and

Tietze, W. (1987). *A structural model for the evaluation of preschool effects*. *Early Childhood Research Quarterly*, 2, 133-153.

That the link between class size and achievement is indirect is suggested in

Levin, H.M., Glass, G.V., & Meister G.R. (1984). *Cost effectiveness of four educational interventions*. Institute for Research on Educational Finance and Governance, Stanford University. Report No. 84-A11 (ED 246633).

and

Mier, M. (1984). Class size and writing instruction. *ERIC Digest* (ED250 689).

That researchers need clear definitions and controlled experiments is in

Vignocchi, N. (1981). What research says about the effect of class size on academic achievement. *Illinois School Research and Development*, 17, 51-54.

Class size and other child variables

Recent publications linking class size and children's motivation, emotions and classroom behaviour

Bain, H.P., Archilles, C.M., Caraher, P., and Whittington, E.H. (1986). *Small class size again: An experiment in Grade One*. *Metro-Nashville Public Schools*. (ED 271196).

and

Campbell, J., and Robinson, M. (1983). Three dozen's a crowd. *set*, No.1., item 12.

and

Glass, *et al.* (1982), above

That there is a consensus that small classes have a positive effect is attested by

Cacha, F.B. (1982). The class size and achievement controversy. *Contemporary Education*, 54:1, 13-17.

and

Cahen *et al.*, above and
Campbell and Robinson, above and
Glass *et al.*, above

Class size and teacher variables

Studies of teacher stress, turnover and burnout include

Russell, D., Altmaier, E., & Van Velzen, D. (1987). Job-related stress, social support, and burnout among classroom teachers. *Journal of Applied Psychology*, 72, 269.

The New Zealand research for the NZEI is found in

Galloway, P., Boswell, K., Panckhurst E., Boswell C., & Green K., (1985). Sources of satisfaction and dissatisfaction for New Zealand primary school teachers. *Educational Research*, 27:1, 44-51.

Class size and organisational/instructional variables

The different types of groupings were discovered and detailed in Bossert, S.T., Barnett, B.G., & Filby, N.N. (1984). Grouping and instructional organization. In P.L. Peterson, L.C. Wilkinson, & M.Hallinan, Eds., *The Social Context of Instruction: Group Organization and Group Process*. San Francisco: Academic Press.

and

Klein, K. (1985). Practical applications of research: The research on class size. *Phi Delta Kappan*, 66:8, 578-580.

The Australian research showing maths teaching better with whole-class instruction is

Bourke, S. (1986). How small is better: Some relationships between class size, teaching practices, and student achievement. *American Educational Research Journal*, 23:4, 558-571.

That grouping young children according to ability has an adverse effect is detailed in

Bossert *et al.*, above

and

Klein, above

and

Savard, W.C., & Cotton, K. (1983). *What effective schooling research says to migrant education program planners*. Paper presented at the Annual National Migrant Education Conference, Portland, Oregon. (ED 230354).

The scope for interactions to increase in small classes is detailed in Hill, W.C. (1981). *Galatea in the classroom: The distribution of teacher-pupil interaction and its relationship to class-size*. (ED 225646).

International research suggests class size effects are mediated by class and group dynamics are in

Albritton T. (1984). *A review of the recent literature on the effects of class size, with implications for English and Language Arts instruction*. (ED 248517).

and

Cahen *et al.*, above

and

Hill, above

Savard and Cotton's research on migrant groups is referenced above

Promotion for Maori children is discussed in

McDonald, G. (1988). Promotion, retention, and acceleration: How the school produces inequality in the face of good intentions. *set*, 1988, No. 2.

Class size and cost effectiveness

The ongoing debates can be found in

Ellis, T. (1984). *Class size*. Centre for Advanced Technology in Technology in Education, University of Oregon. (ED 259454).

and

Jamison, D.T. (1982). Reduced class size and other alternatives for improving schools: An economist's view. In G.V. Glass, L.S. Cahen, M.L. Smith, & N.N. Filby, *School Class Size: Research and Policy*. Beverly Hills: Sage Publications.

and

Levin *et al.*, above

The unique characteristics of small classes

Recent studies on this topic

Berger, M.A. (1982). *Class size is not the issue*. Paper presented to the annual meeting of the National School Boards Association, Atlanta, Georgia. (ED 231061).

and

ERS Staff Report. (1985). Teachers and class size: Their problems and views. *ERS Spectrum*, 3:4, 33-39.

Experimental studies of classes of 10 to 15 are

Indiana State Department Of Public Administration, Indianapolis (Division of Curriculum). (1983). *Project Prunetime: 1982-83 Report*. (ED 239765).

and

Bain *et al.*, above and

Klien, above

The study in Nashville is found written up in Bain *et al.*, above.

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